INVESTIGATORY PROJECT

BIOLOGY

TOPIC : PEDIGREE CHART AND ITS ANALYSIS

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This is to certify that GAYATHRI P.R of class XII-A has successfully completed the research on the topic

PEDIGREE CHART AND ITS ANALYSIS

under the guidance of Mrs. ASHADEVI P.K during year 2024-25.

Internal Examiner *External Examiner*

Principal:

ACKNOWLEDGEMENT

In the accomplishment of this project successfully, many people have best owned upon me their blessings and the heart pledged support. I would like to utilize this opportunity to thank all the people who have been part of this project.

Primarily I would thank god for being able to complete this project with success. Then I would like to thank my principal SUDHAKARAN P.V and biology teacher ASHADEVI P.K, whose valuable guidance has been the ones that helped me patch this project and make it full proof success. His suggestions and his instructions have served as the major contributor towards the completion of the project.

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INTRODUCTION

PEDIGREE CHART AND ITS ANALYSIS

What is a Pedigree Chart?

A pedigree chart is a diagram that represents the lineage or genealogy of an individual, illustrating family relationships and the inheritance of specific traits across generations. It uses standardized symbols—squares for males, circles for females, and lines to show relationships and offspring. Shaded symbols indicate individuals who express a particular trait or genetic condition. Pedigree charts are widely used in genetics, medicine, and animal breeding to trace hereditary patterns, identify carriers of genetic disorders, and predict the likelihood of traits being passed on. They are valuable tools for visualizing and analyzing familial and genetic data.

Symbols Used in Pedigree

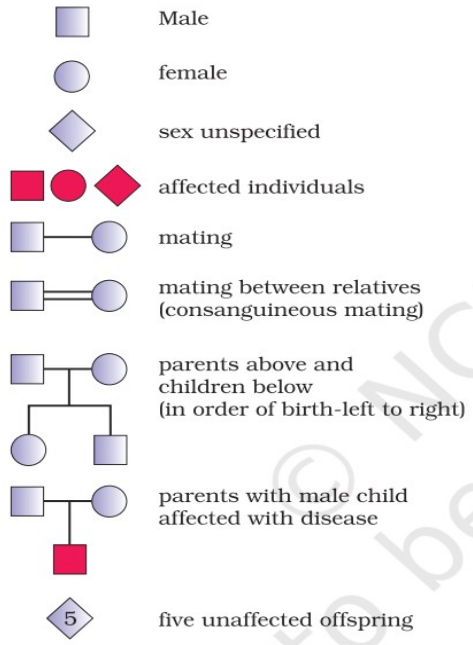


Figure 4.13 Symbols used in the human pedigree analysis

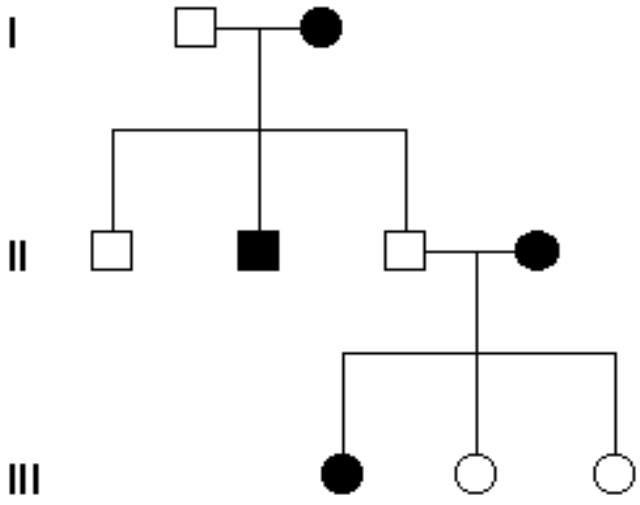
Once phenotypic data is collected from several generations and the pedigree is drawn, careful analysis will allow you to determine whether the trait is dominant or recessive. Here are some rules to follow.

For those traits exhibiting dominant gene action:

- affected individuals have at least one affected parent
- the phenotype generally appears every generation
- two unaffected parents only have unaffected offspring

The following is the pedigree of a trait controlled by dominant gene action.

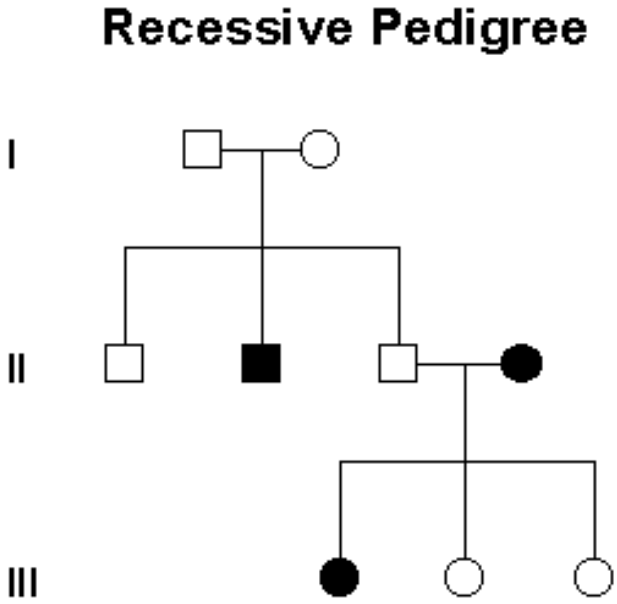
Dominant Pedigree



And for those traits exhibiting recessive gene action:

- unaffected parents can have affected offspring
- affected progeny are both male and female

To the right is the pedigree of a trait controlled by recessive gene action.



USES OF PEDIGREE CHARTS

1. **Tracking Genetic Traits**
   Pedigree charts help trace the inheritance of specific traits, such as eye color, hair color, or genetic disorders, through generations.
2. **Diagnosing Genetic Disorders**
   - Helps geneticists or medical professionals identify whether a condition is **dominant**, **recessive**, or **sex-linked**.
   - Useful in identifying carriers of genetic disorders.
3. **Counseling in Medicine**
   - Helps genetic counselors predict the likelihood of offspring inheriting a genetic condition.
   - Assists in risk assessment for prospective parents with family histories of genetic disorders.
4. **Animal Breeding**
   - Widely used to document lineage and ensure desirable traits are passed on in livestock, pets, and race animals.
   - Helps avoid inbreeding by identifying relationships within populations.
5. **Research and Education**
   - Used in biology and genetics education to teach concepts of inheritance and trait prediction.
   - Valuable in genetic studies and experiments involving inheritance patterns.
6. **Legal and Forensic Uses**
   - Occasionally used in cases of disputed parentage or inheritance claims to establish biological relationships.

BENEFITS OF USING PEDIGREE CHARTS

- **Visualization:** Simplifies complex family histories into an easily interpretable format.
- **Analysis of Patterns:** Facilitates the study of how traits or disorders are transmitted over generations.
- **Prediction:** Helps in forecasting the likelihood of traits appearing in future generations.

PROJECT FAMILY PEDIGREE ANALYSIS OF BLOOD GROUP INHERITANCE

Objective:

To analyze the inheritance of blood groups across three generations in two different families and demonstrate how blood groups are passed from one generation to another using a pedigree chart.

Requirements: Blood group data of family members from three generations of two families and Pedigree chart.

Theory:

- The gene responsible for determining the blood group in humans exists in three alleles: I^A, I^B, and i. An individual inherits two alleles, one from each parent, to determine their blood group. The I^A and I^B alleles are dominant over the i allele, meaning that if an individual has either I^A or I^B in combination with i, the resulting blood group will be either A or B,

respectively. When both I^A and I^B alleles are inherited, they are co-dominant, leading to the AB blood group. The i allele is recessive, and an individual can only have blood group O if they inherit two i alleles, one from each parent

- The inheritance of blood groups follows¬ Mendelian inheritance patterns, with the I^A, I^B, and i alleles distributed randomly from parent to offspring. Blood group is an example of multiple allelism,¬ where more than two alleles control a single trait.
- Understanding the genotypes of parents can help¬ predict the possible blood groups of their children using a Punnett square.

BLOOD GROUP	GENOTYPES
A	I^A I^A or I^A i
B	I^B I^B or I^B i
AB	I^A I^B
O	i i

Procedure:

Two different families, each with three generations of family members, are studied in terms of the blood groups of individuals across these generations, as shown in the pedigree chart. The study examines how blood groups are inherited from one generation to the next.

- Collect the blood group data of all family members from two different families. The

families should include three generations, Generation 1 (Grandparents): Blood groups of both maternal and paternal grandparents. Generation 2 (Parents): Blood groups of the parents (children of Generation 1). Generation 3 (Children): Blood groups of the children (offspring of Generation 2).

- Create a pedigree chart to represent the family¬ structure across the three generations.
- Determine Possible Genotypes for Each Blood¬ Group.

The Pedigree Chart Analysis Family

The Pedigree Chart Analysis
Family 1

The Pedigree Chart Analysis Family 1

The pedigree chart above represents the inheritance of blood groups within a family across

three generations. In this chart, circles represent females, and squares represent males.

Generation 1 (Father's Side): The grandfather, who has blood group A, married a woman with blood group O. Together, they had seven children (Generation 2): six sons and one daughter. Among these children, four have blood group O, and three have blood group A. This suggests that the grandfather’s blood group is A and the grandmother’s blood group is O.

Generation 1 (Mother's Side): The maternal grandfather has blood group B, and the maternal grandmother has blood group A. Their daughter (Generation 2) has blood group A but produced children with blood group O (Generation 3). This indicates that the mother on this side has blood group A, and the father has blood group B.

Generation 2: One of the sons from Generation 2, who has blood group O, marries a woman with blood group A. Together, they have two children (Generation 3): one son and one daughter, both of whom have blood group O.

Generation 3: The children of the son with blood group O and the woman with blood group A (from Generation 2) are both of blood group O.

Solution

Solution

Solution;

The possible genotypes of different individuals across generations are shown in the pedigree chart above.

Generation 1 (Father's Side): The grandfather has blood group A, and the grandmother has blood group O. They produced children with blood groups A and O, which indicates that the grandfather's genotype must be heterozygous I^A i, as this genotype can produce offspring with blood group O. Therefore, the grandfather’s genotype is heterozygous I^A i (blood group A), and the grandmother’s genotype is ii(blood group O).

Generation 1 (Mother's Side): The maternal grandfather has blood group B, and the maternal grandmother has blood group A. Their daughter (Generation 2) has blood group A and produced children with blood group O (Generation 3). This suggests that the mother (Generation 2) must have the heterozygous I^A i genotype, as she can pass on the O blood group. However, the maternal grandmother’s blood group cannot be definitively determined from this information, as she could either be **homozygous I^A I^A or heterozygous I^A i. Both genotypes could allow her to have a child with a heterozygous blood group A (I^A i). Therefore, the genotypes of the parents on the

mother’s side are: Mother (Generation 2): heterozygous I^A i (blood group A) Father (Generation 1, maternal grandfather): heterozygous I^B i (blood group B)

Generation 2: One of the sons from Generation 2, who has blood group O, marries a woman with blood group A. The son has blood group O, which means his genotype is ii. The woman with blood group A must have the heterozygous I^A i genotype, as she can have children with blood group O. Together, they have two children (Generation 3), both of whom have blood group O.

Generation 3: The two children of the couple in Generation 2, both with blood group O, have the genotype ii. They are son and daughter with blood group O

The Pedigree Chart Analysis
Family 2

The Pedigree Chart Analysis
Family 2

The Pedigree Chart Analysis Family 2

The pedigree chart above represents the inheritance of blood groups in a family across generations. In this chart, circles represent females, and squares represent males.

Generation 1 (Father's side): A man with blood group A married a woman with blood group B. They had two children: one son with blood group B and another with blood group AB. Generation 1 (Mother's side): The maternal grandfather had blood group B, and the maternal grandmother had blood group O.

Generation 2: One of the sons from Generation 2, who has blood group B, married a woman with blood group O.

Generation 3: The couple from Generation 2 had two sons, both of whom have blood group O.

Solution

Solution

Solution:

The possible genotypes of different individuals across generations are shown in the pedigree chart above.

Generation 1 (Father's side): The grandfather has blood group A and the grandmother has blood group B. They produced children with blood groups AB and B. This indicates that the grandfather (blood group A) must have the heterozygous genotype I^A i. This is because the A group can only produce children with the B blood group if the father is heterozygous for A. The grandmother (blood group B) could have the genotype I^B i or I^B I^B. However, since the son (Generation 2) has blood group B and can produce children with blood group O in Generation 3**,** it is confirmed that

the genotype of the father (blood group B) must be heterozygous I^B i.

Generation 1 (Mother's side): The maternal grandfather has blood group B, and the maternal grandmother has blood group O. Since the child (Generation 2) has blood group O, it is confirmed that the father (maternal grandfather) must have the heterozygous genotype I^B i. The mother (maternal grandmother) must have the homozygous genotype ii for blood group O.

Generation 2: One of the sons from Generation 2 has blood group B and marries a woman with blood group O. Based on their children (Generation 3) having blood group O, it is confirmed that the son from Generation 2 (blood group B) has the heterozygous genotype I^B i. The woman (blood group O) must have the genotype ii.

Generation 3: The couple from Generation 2 has two children, both of whom have blood group O. This confirms that the father from Generation 2 (blood group B) must be heterozygous I^B i, as this combination allows for the possibility of offspring with blood group O.

Result:

From the pedigree chart following can be concluded:

- Blood group is an Autosomal trait.
- This trait is inherited according to the Mendel's
- Law of Inheritance. The pedigree chart clearly shows how blood group traits are passed down generations.

- Predict future blood groups in subsequent generations based on the current patterns of inheritance.

Precautions:

- Ensure accurate blood group data is obtained.
- Double-check the pedigree chart for correct representation of family relationships.
- Be aware of cases where blood group inheritance may not fit typical Mendelian patterns due to mutations or other genetic factors.

BIBLIOGRAPHY

- NCERT Textbook Class 12

- Class 12 Comprehensive Biology Lab Manual

- Google Website